Overview of Preliminary Results for SEAC^{4}RS from the Whole Air Sampler (WAS): Spatial Distributions and Source Characterization

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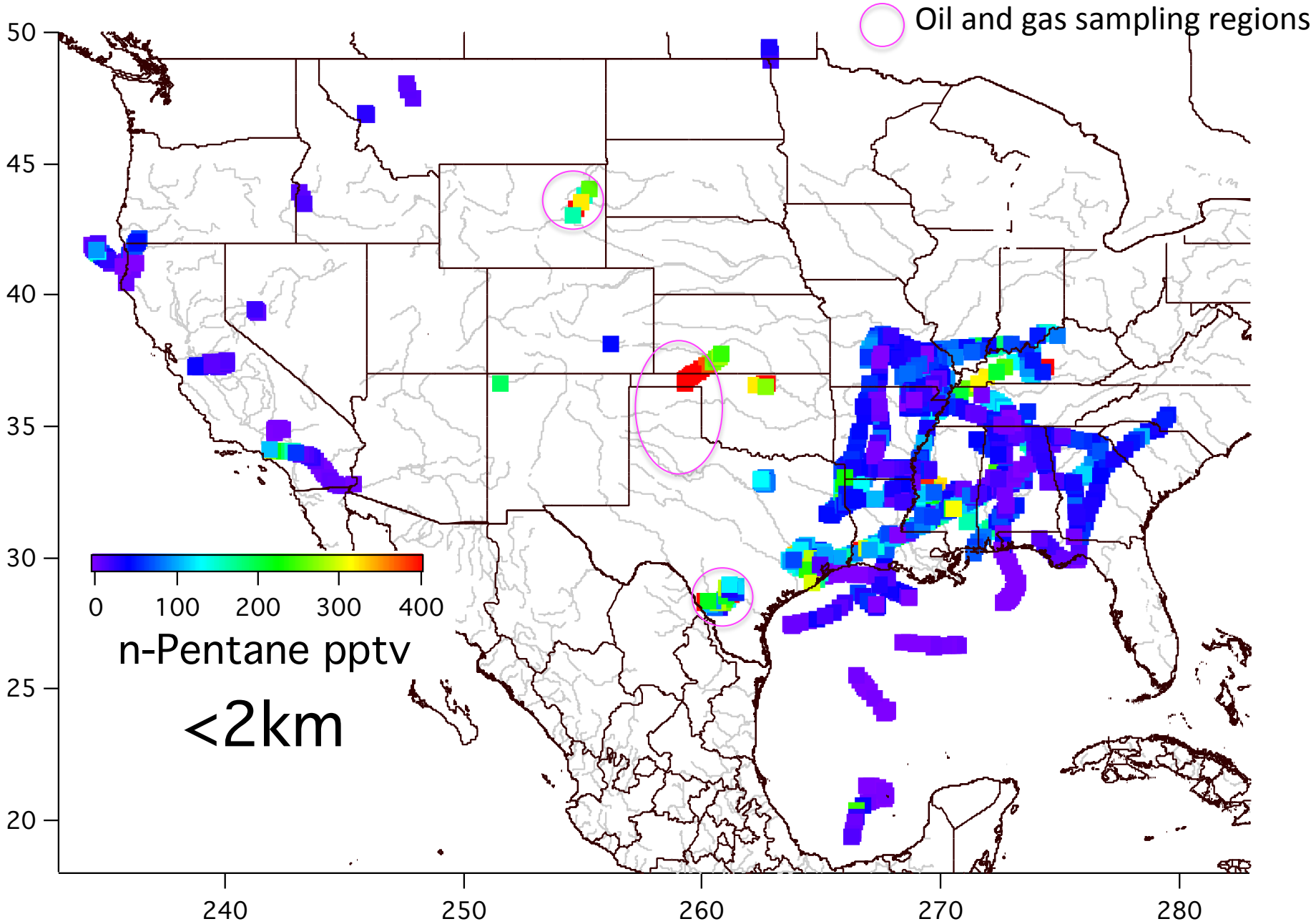
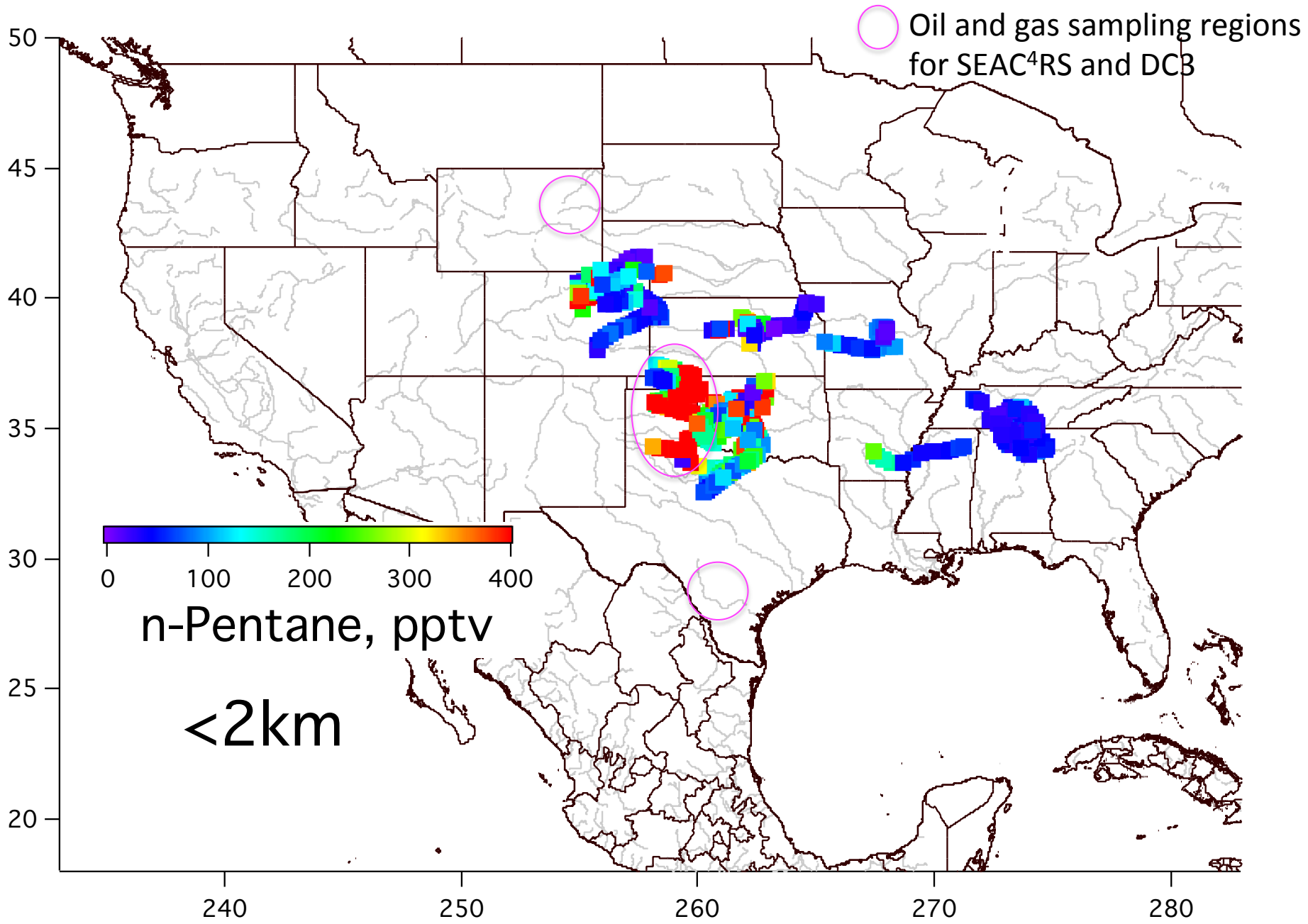
Glen Diskin – NASA

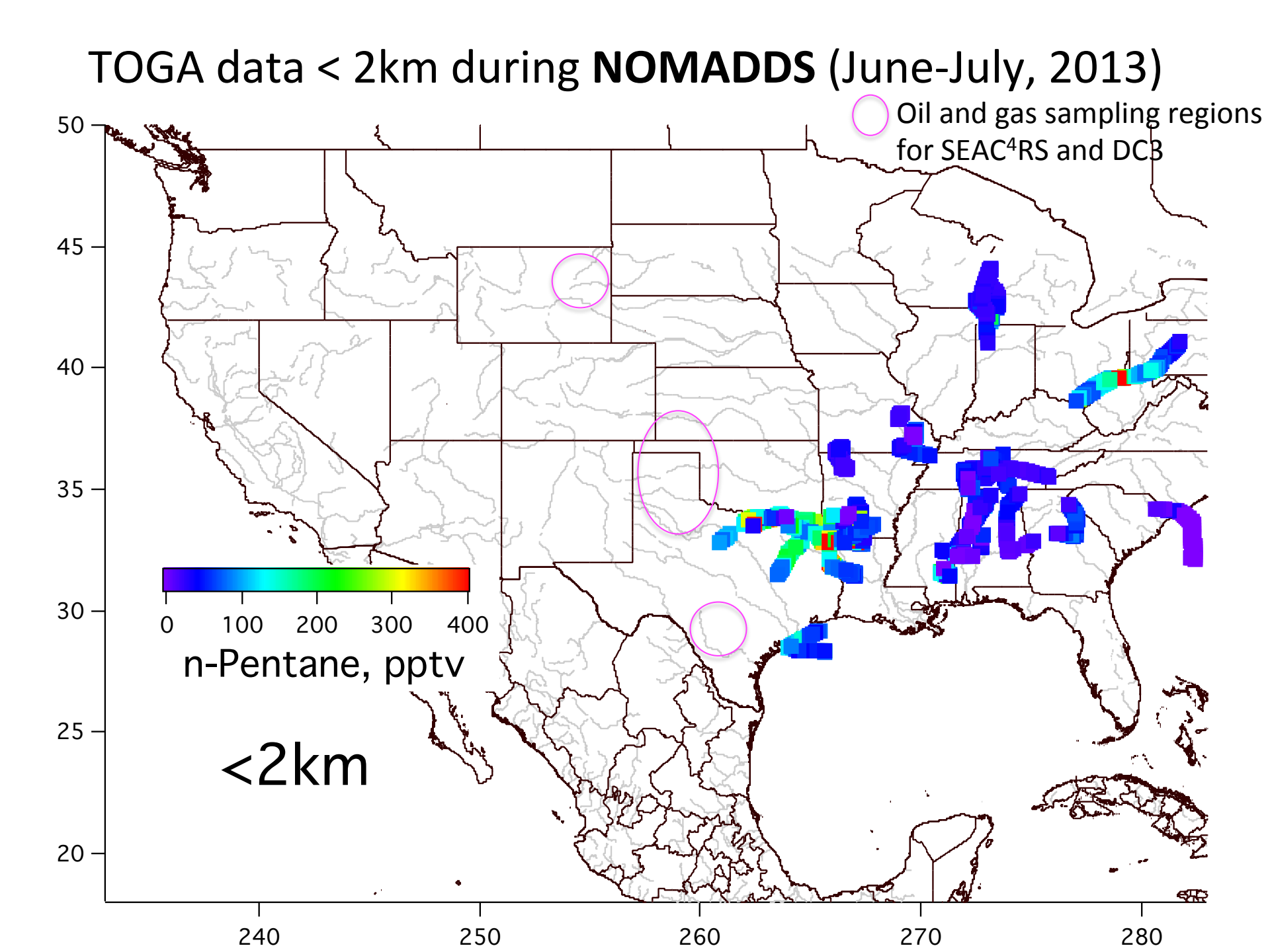
SEAC^{4}RS Science Team

WAS data < 2km during **SEAC^{4}RS** (Aug-Sep 2013)

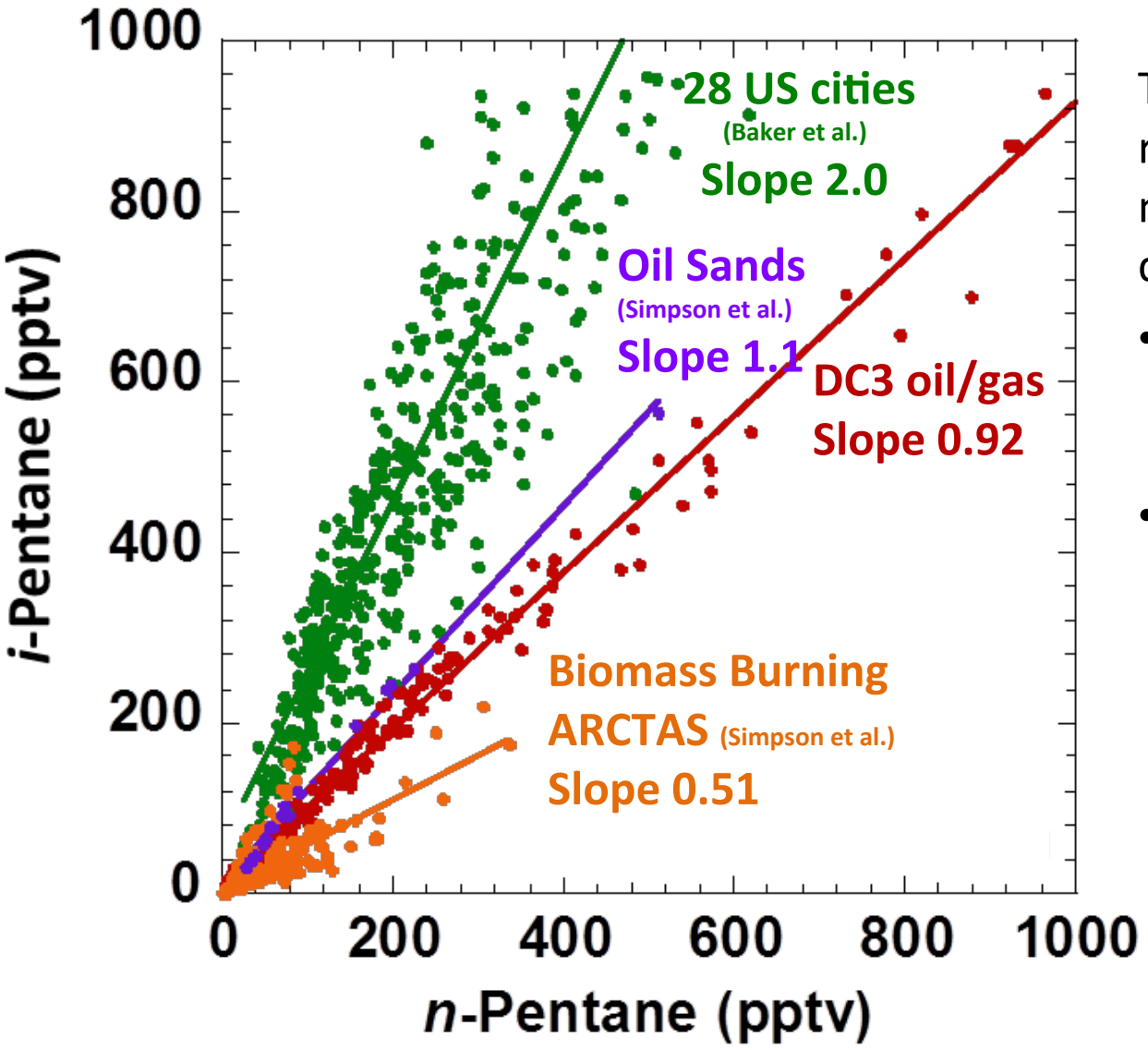


WAS & TOGA data < 2km during **DC3** (May-June, 2012)




TOGA data < 2km during **NOMADDS** (June-July, 2013)
Oil and gas sampling regions for SEAC⁴RS and DC3
50
45
40
35
30
25
20
240
250
260
270
280
0
100
200
300
400
n-Pentane, pptv
<2km

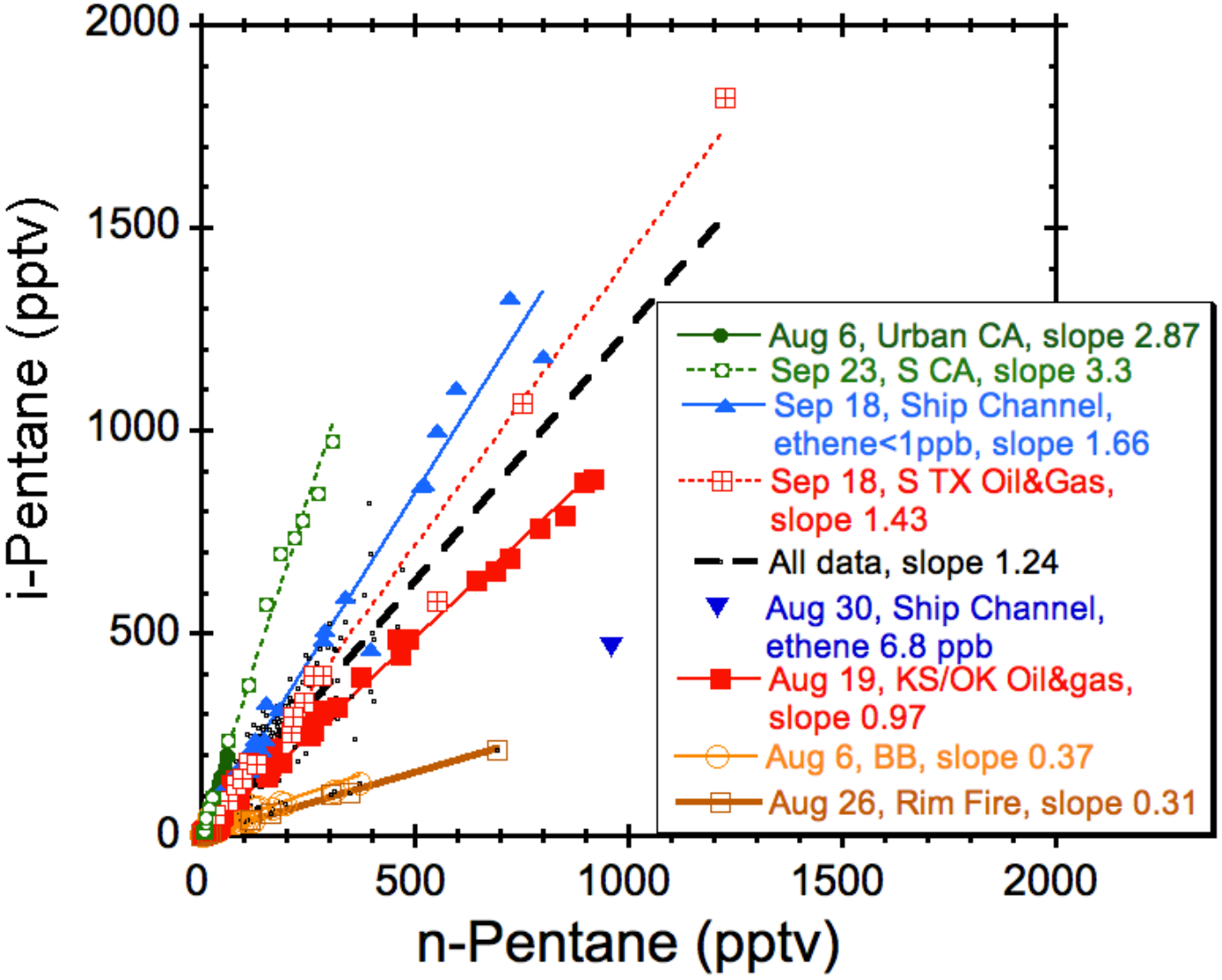
[i-Pentane] vs. [n-Pentane] Signatures for **DC3 and Other Sources**



The [i-pentane]/[n-pentane] ratio associated with an air mass can be a useful tool to discern sources because:

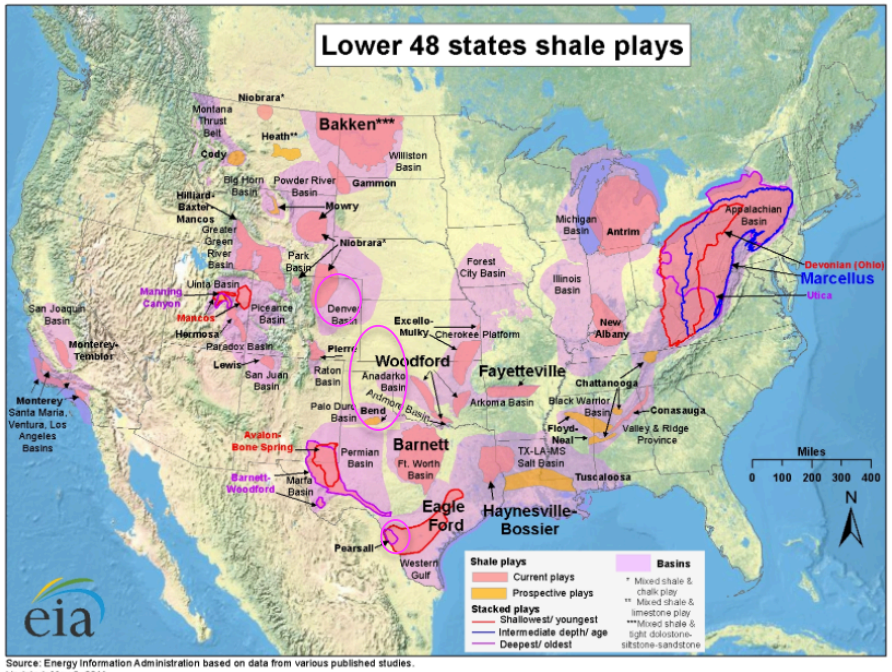
- The pentanes are co-emitted from different sources.
- They have similar reaction rate constants so the ratio is preserved as they age.

[i-Pentane] vs. [n-Pentane] Signatures for **SEAC^{4}RS**



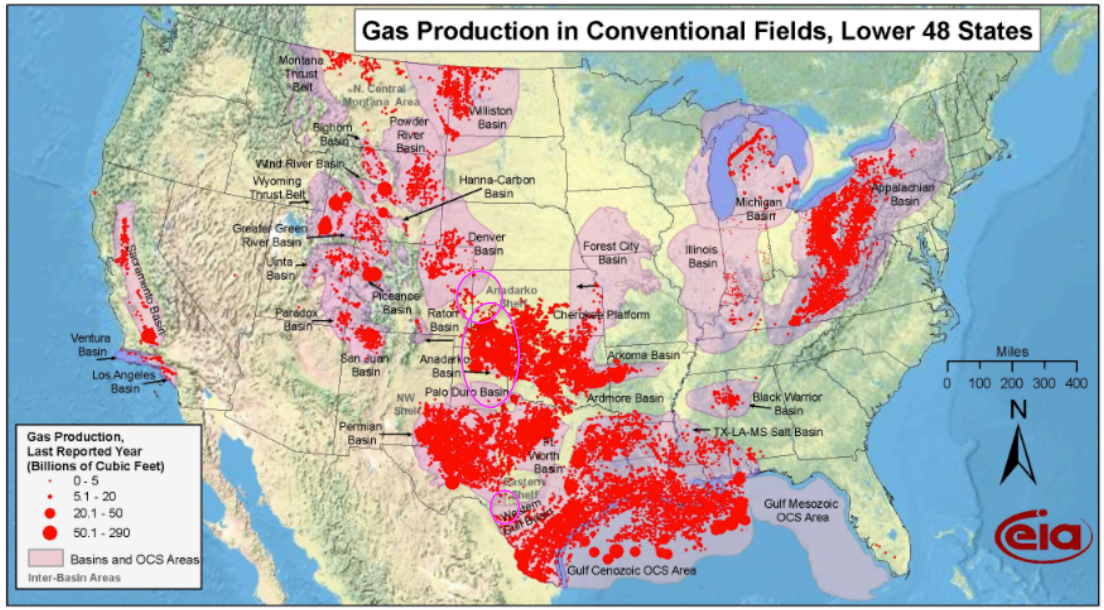
- Pentane ratios for SEAC^{4}RS much more variable than for CO and TX/KS/OK oil & gas -dominated DC3
- SEAC^{4}RS over KS/OK oil&gas had similar ratios to DC3 (~1)
- Coastal TX oil & gas/ fracking had a steeper slope (1.4)
- Houston/ship channel slope 1.66 between urban and oil&gas/ very high ethene point – mixing?
- Slopes for urban and BB were similar to previous work

Oil and Gas Sources



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

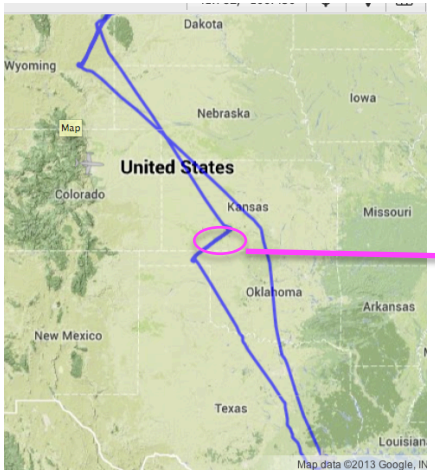
The past decade has seen rapid development of natural gas extraction operations in North America using unconventional methods including hydraulic fracturing or “fracking”.

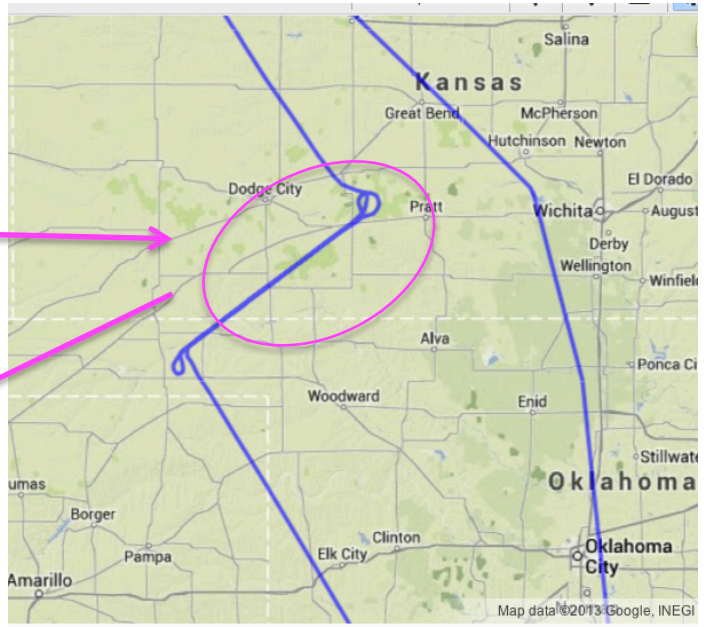


Source: Energy Information Administration based on data from HPDI, IN Geological Survey, USGS
Updated: April 8, 2009

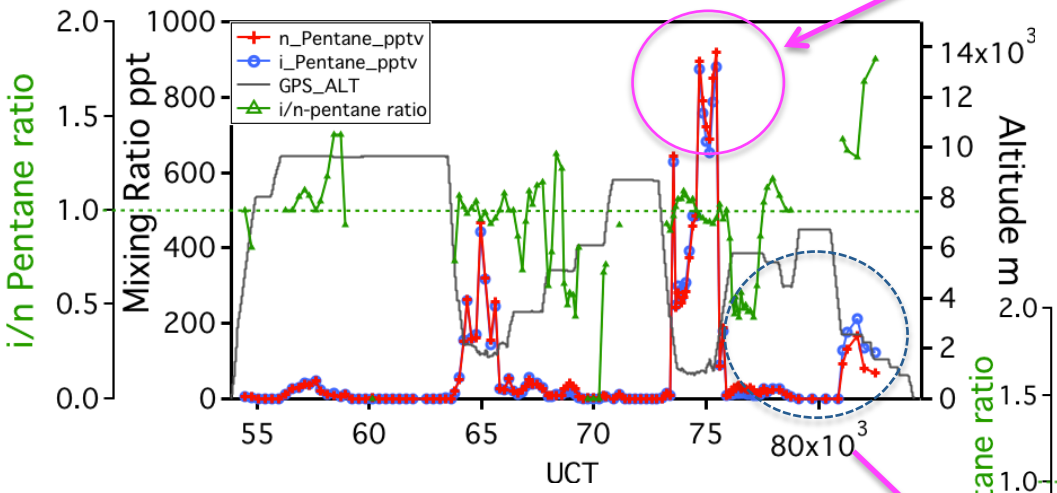
Oil and Gas Signature during **SEAC⁴RS**

DC-8 Flight August 19 2013

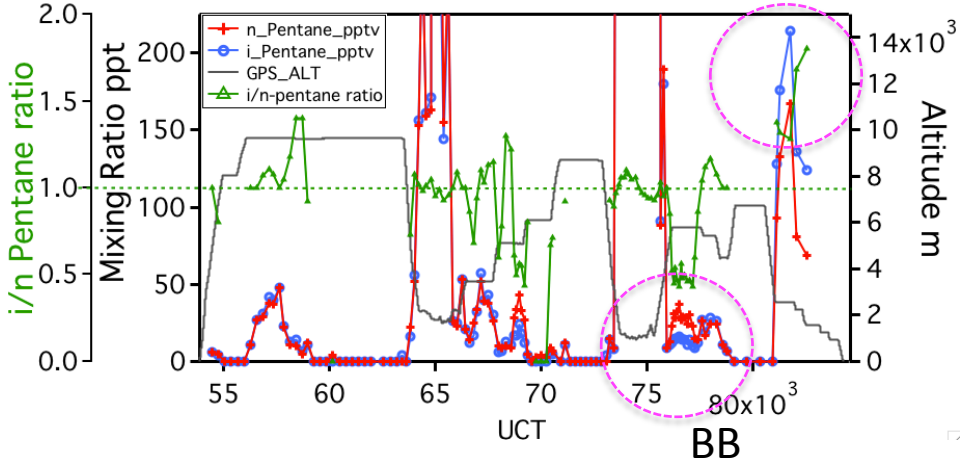




Oil and Gas



Urban

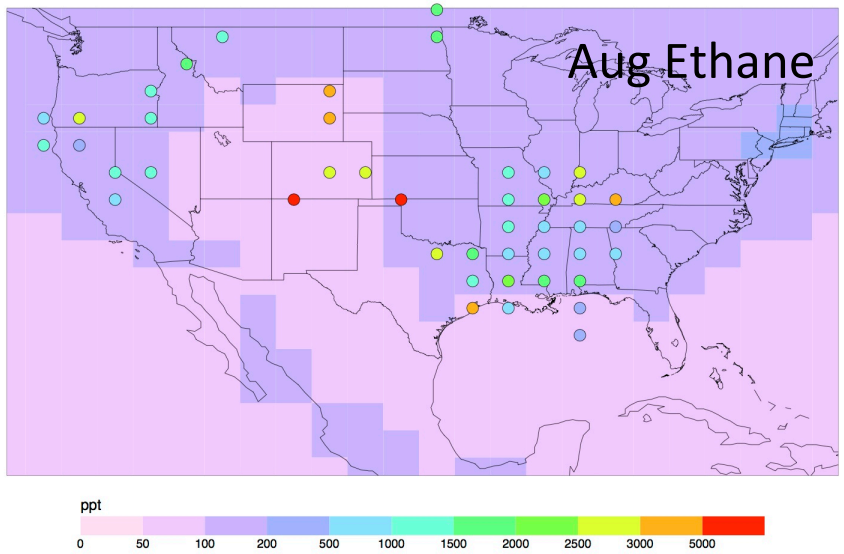


BB

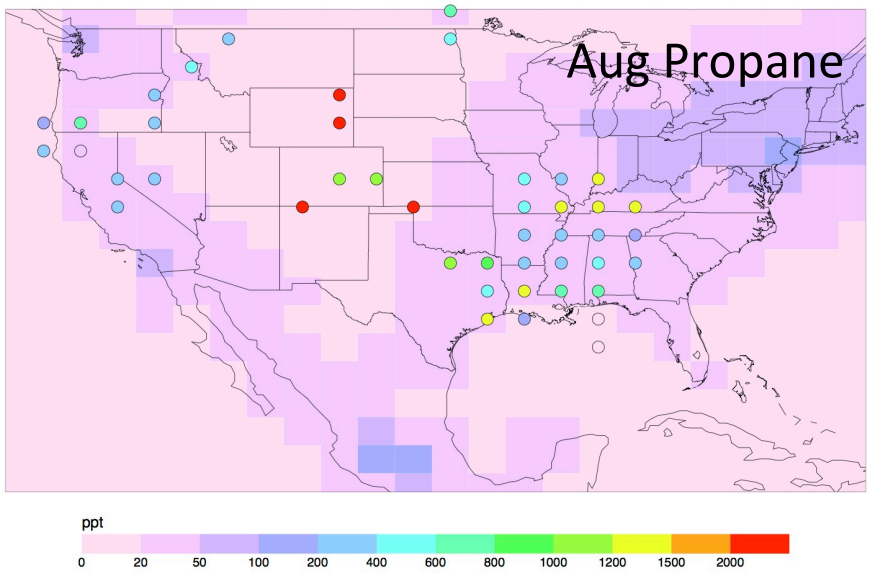
SEAC⁴RS - Model Comparison to WAS Ethane and Propane

- Significant sources missing from emissions inventory – Oil&Gas, Fires, …

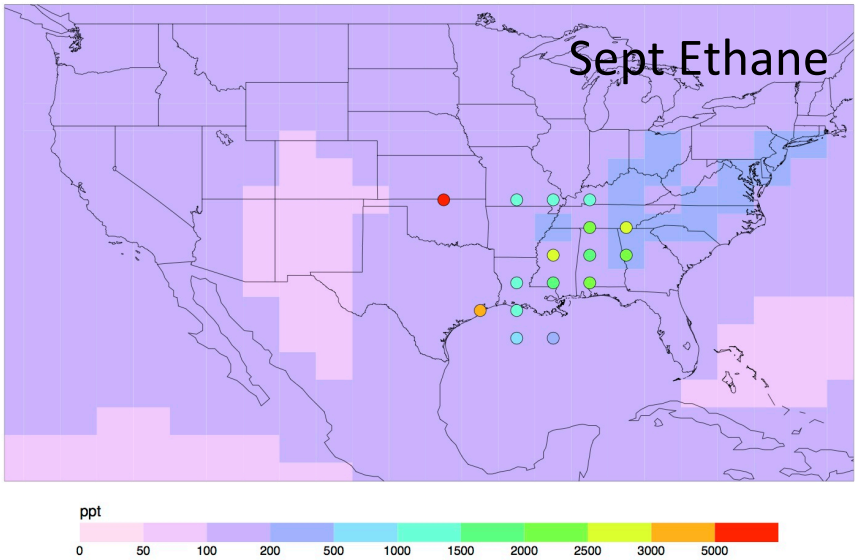
CAM-chem and DC-8 Obs (alt<2km) - Aug - C2H6



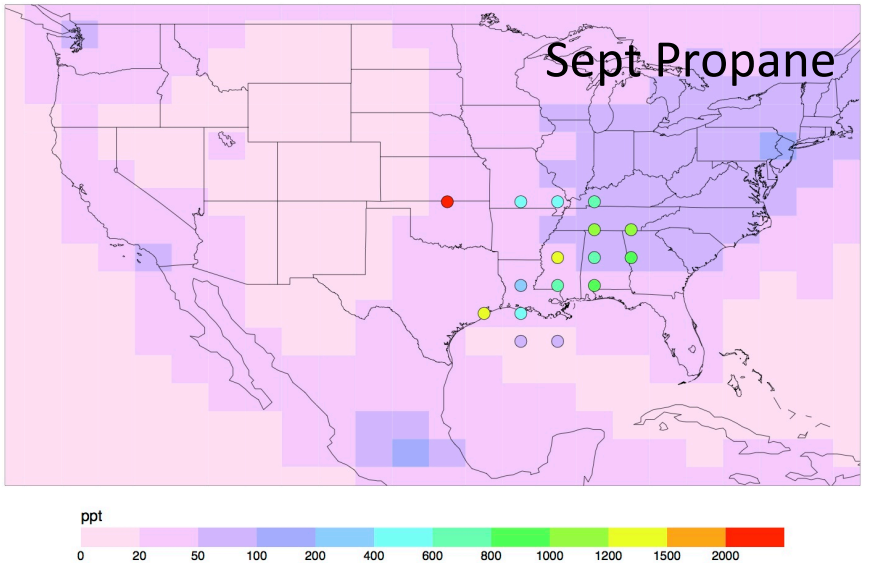
CAM-chem and DC-8 Obs (alt<2km) - Aug - C3H8



CAM-chem and DC-8 Obs (alt<2km) - Sept - C2H6

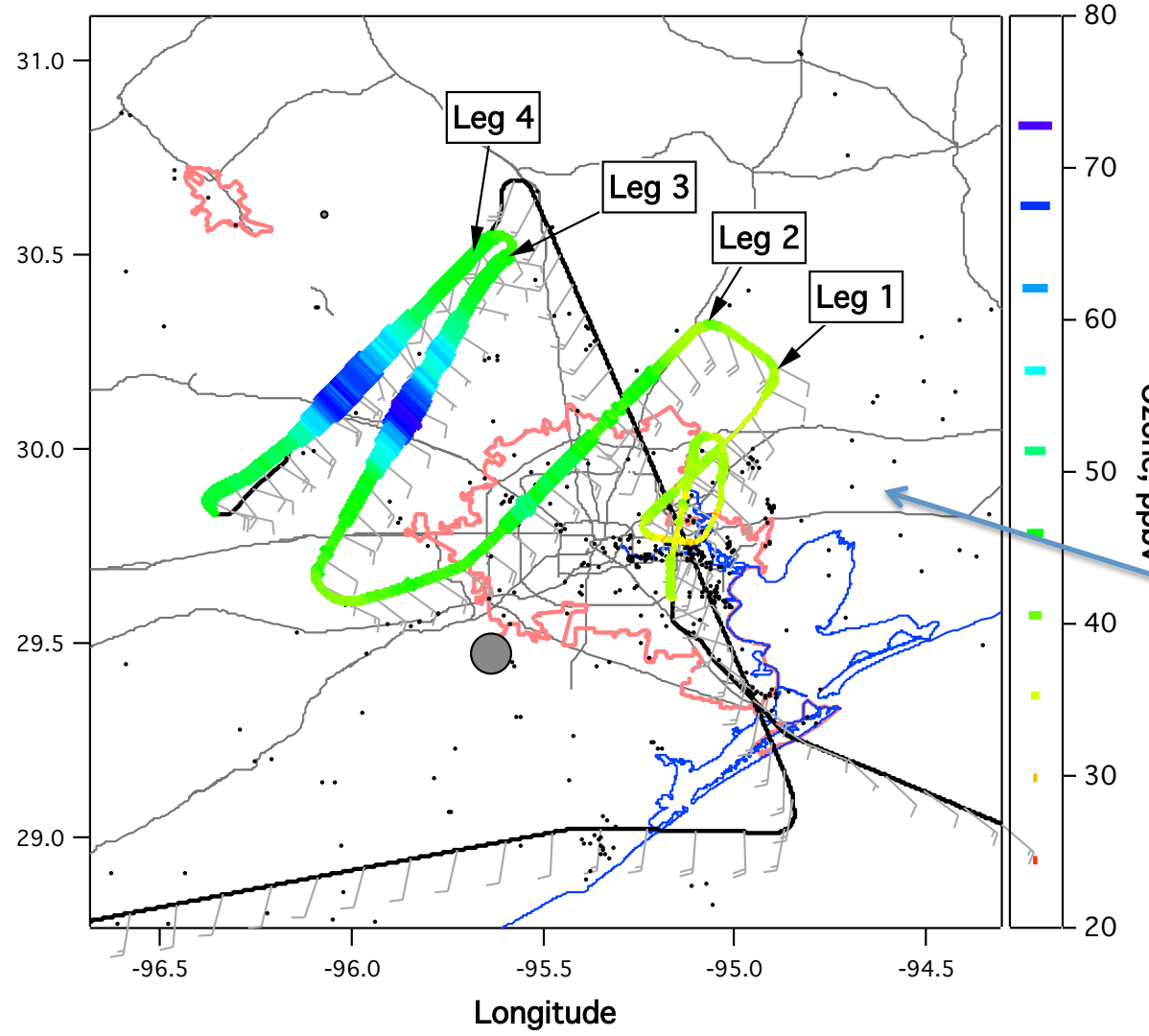


CAM-chem and DC-8 Obs (alt<2km) - Sept - C3H8

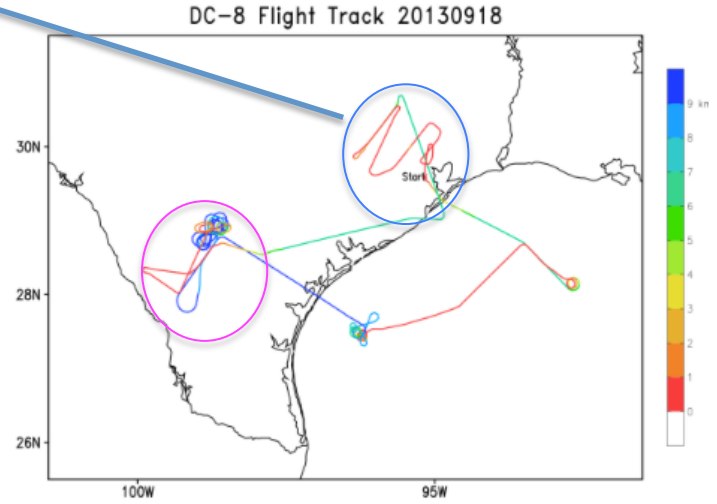


Houston/Ship Channel Signature during **SEAC⁴RS**

DC-8 Flight September 18 2013

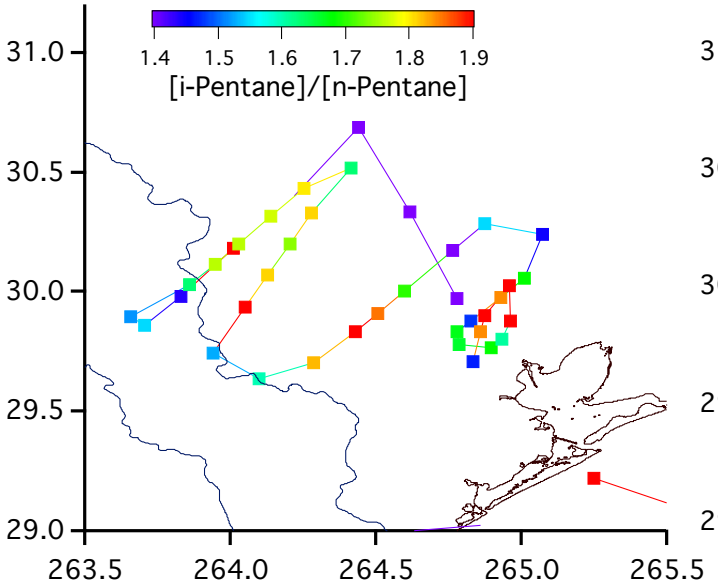


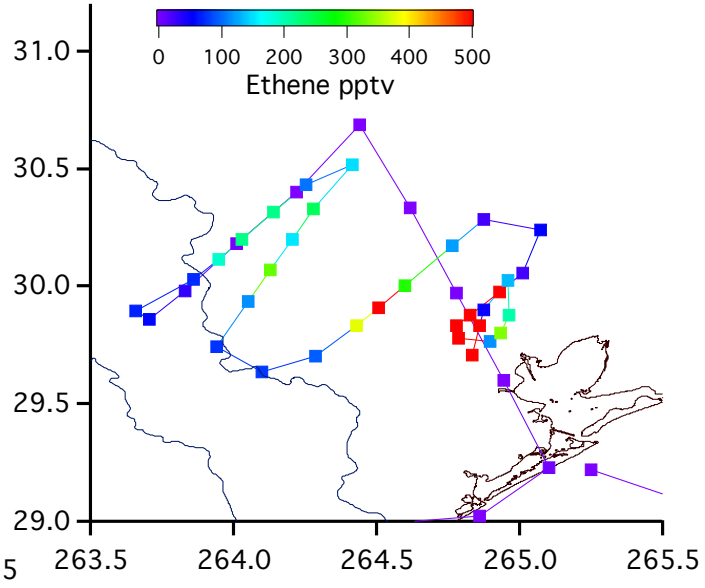
In addition to Gulf and oil/gas/ fracking sampling this flight targeted target industrial and refinery emissions from facilities along the Ship Channel characterized by high ethene – superimposed on the Houston urban plume

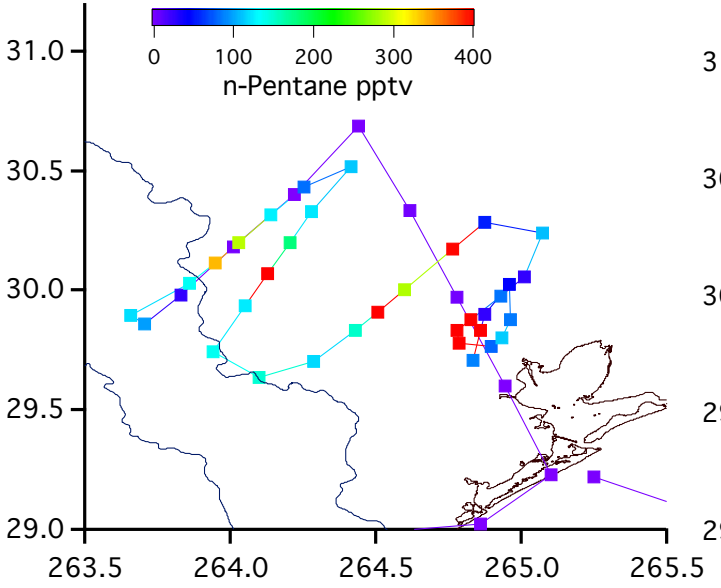


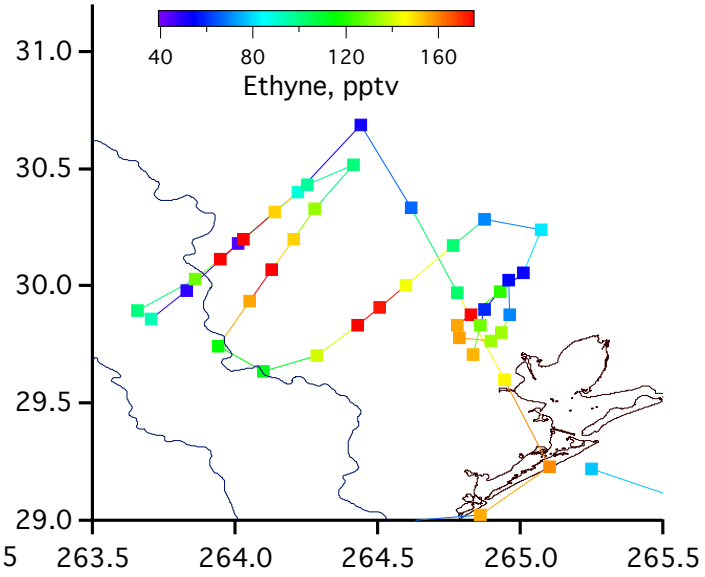
Houston/Ship Channel Signature during **SEAC^{4}RS**

DC-8 Flight September 18 2013





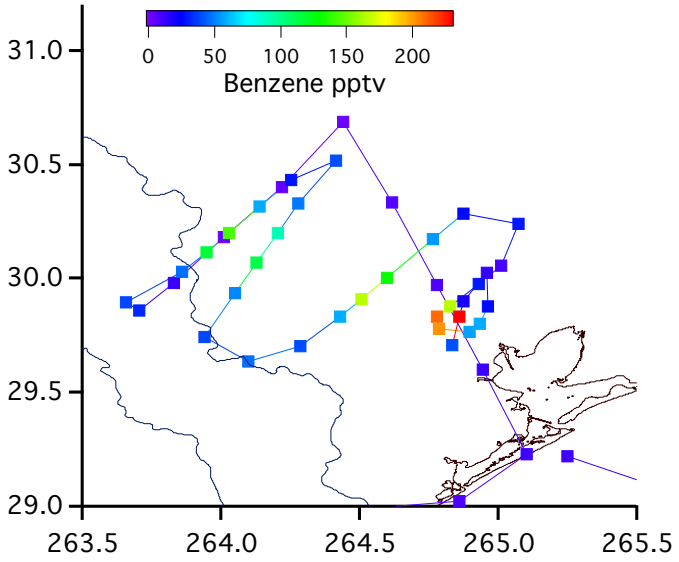


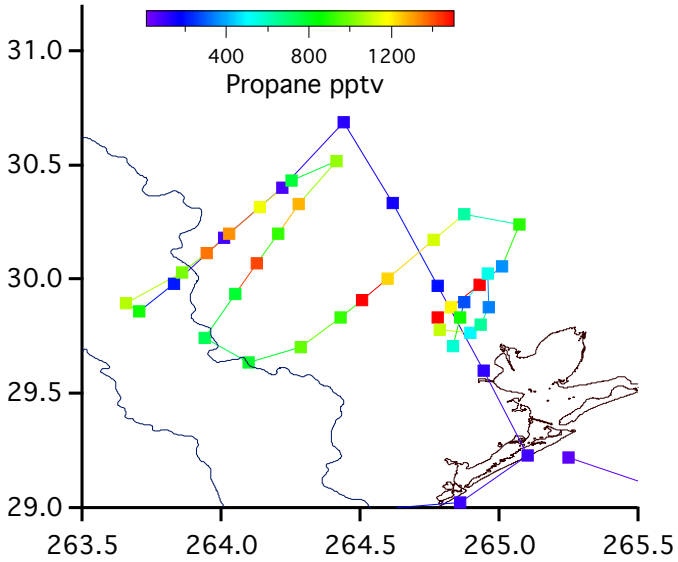


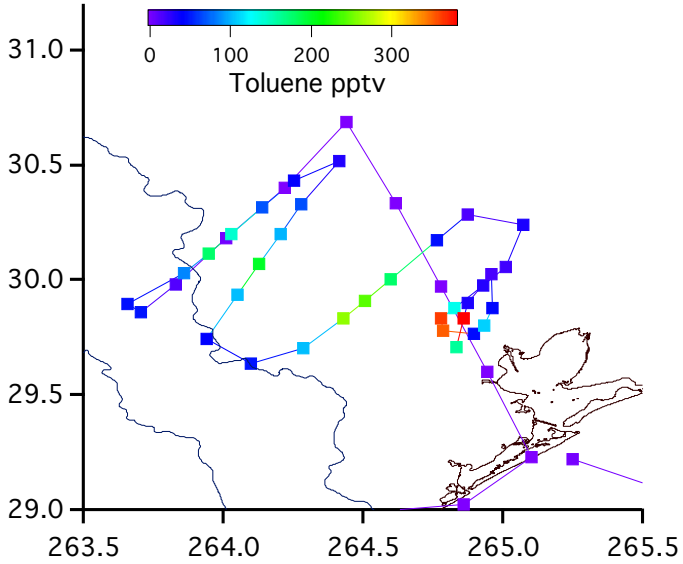
Looking at various tracers to try to separate out the different emission types….
Eg., the highest ethene near the ship channel corresponds with relatively low i/ n- pentane?

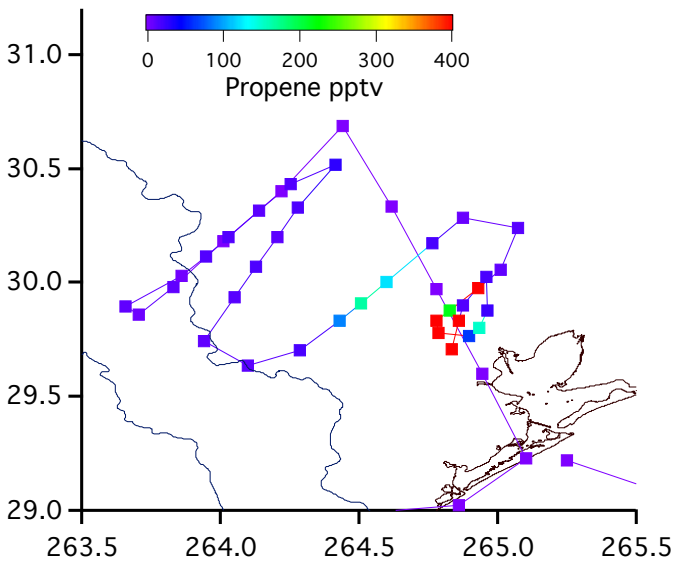
Houston/Ship Channel Signature during **SEAC^{4}RS**

DC-8 Flight September 18 2013

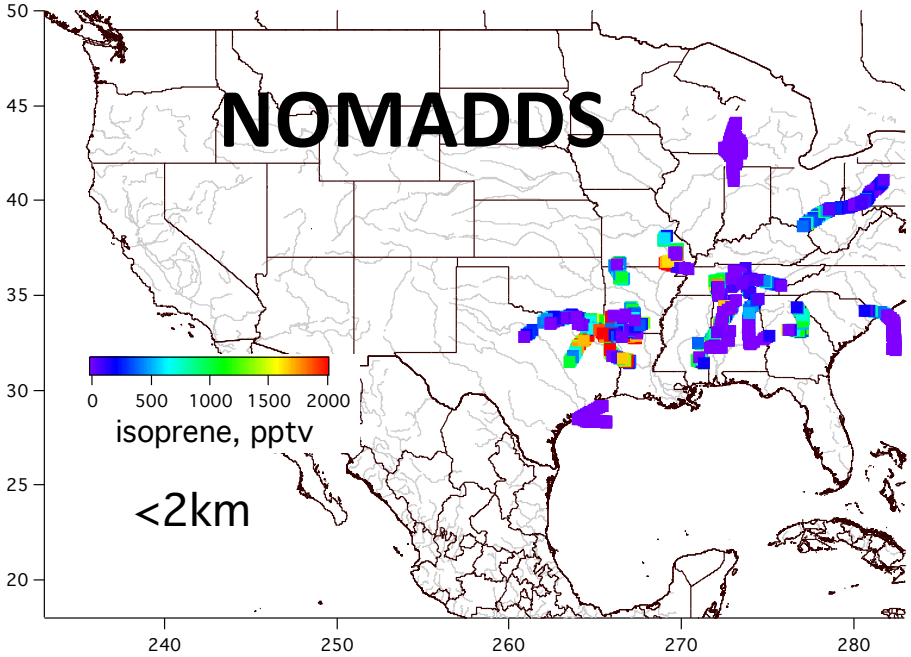


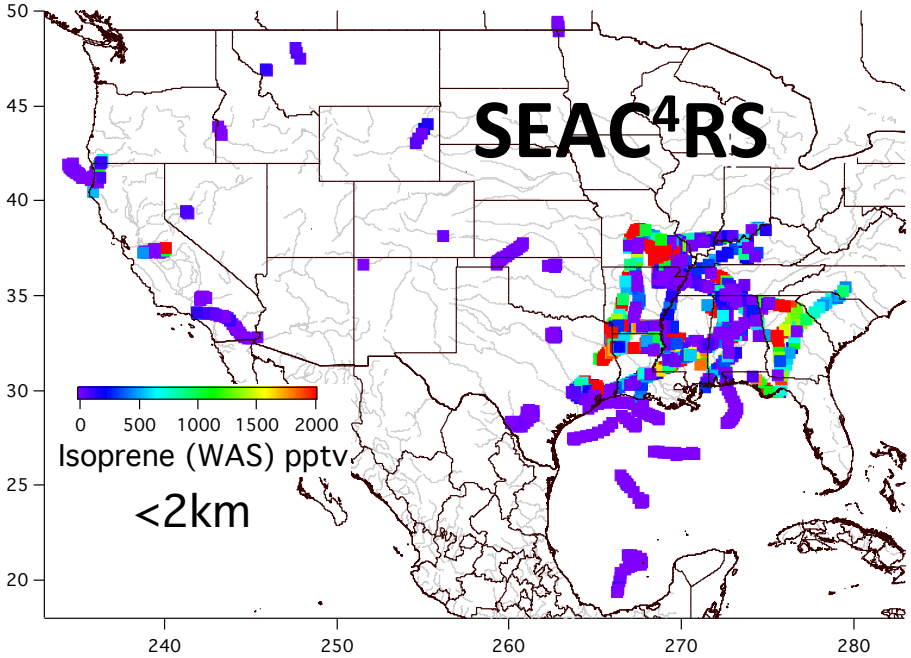


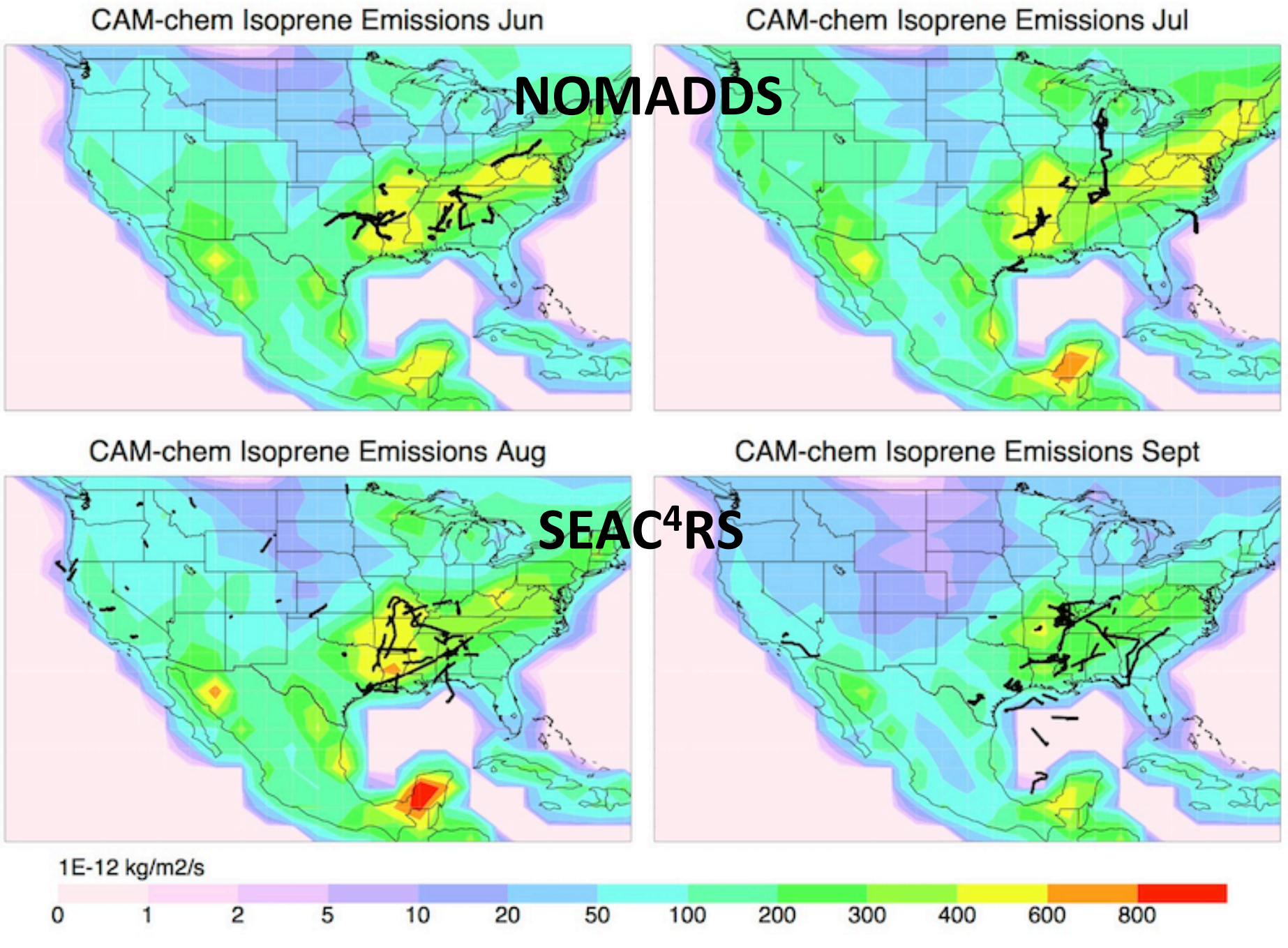




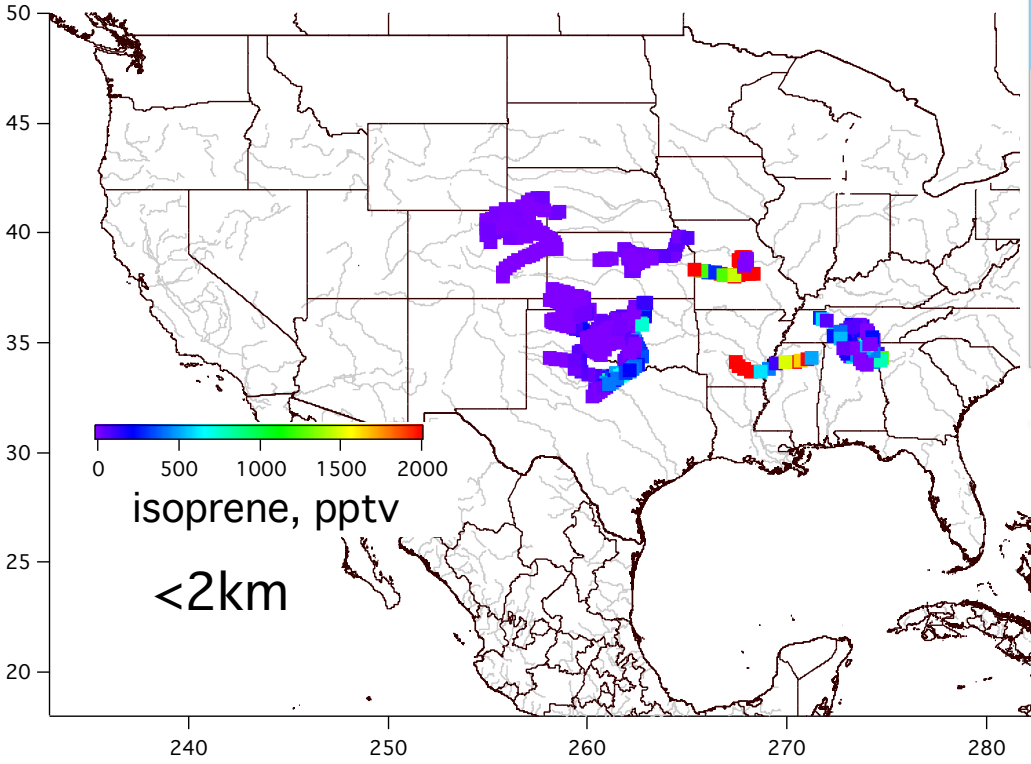
Looking at various tracers to try to separate out the different emission types….

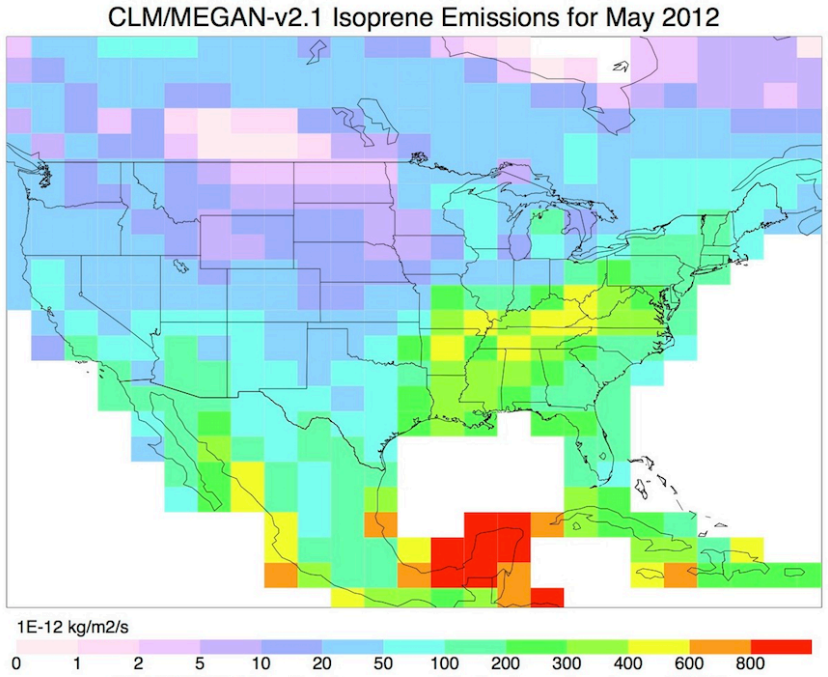

NOMADDS
0 500 1000 1500 2000
isoprene, pptv
<2km
50
45
40
35
30
25
20
240
250
260
270
280

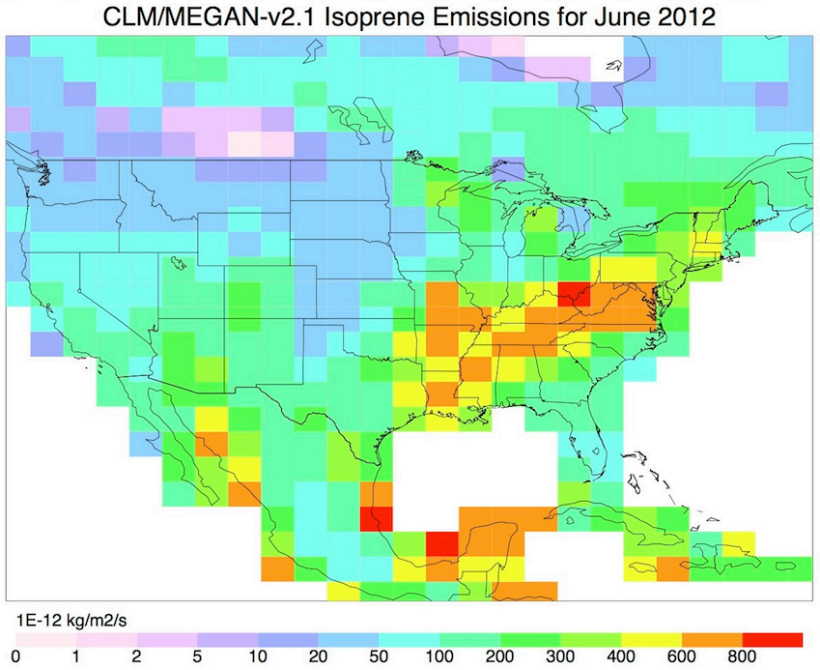

SEAC4RS
0 500 1000 1500 2000
Isoprene (WAS) pptv
<2km
50
45
40
35
30
25
20
240
250
260
270
280


CAM-chem Isoprene Emissions Jun
CAM-chem Isoprene Emissions Jul
NOMADDS
CAM-chem Isoprene Emissions Aug
CAM-chem Isoprene Emissions Sept
SEAC4RS
1E-12 kg/m2/s
0
1
2
5
10
20
50
100
200
300
400
600
800

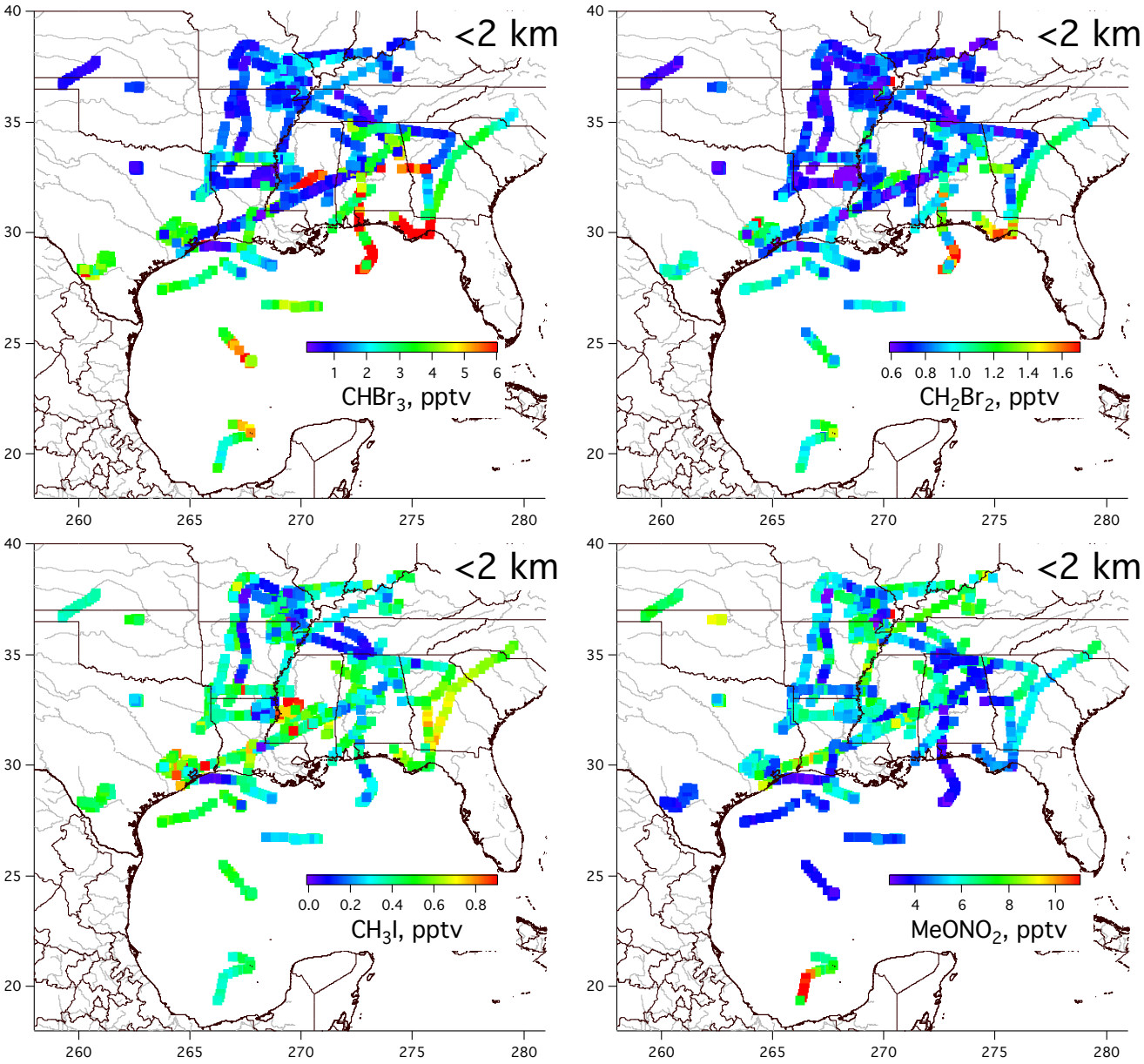
WAS & TOGA data during **DC3** (May-June, 2012)







WAS data< 2km during **SEAC^{4}RS** (Aug-Sep 2013)
Natural Sources



- Variable mixing ratios of "ocean source" gases
- Need to look at trajectories for enhancements over land